



HEALTH-BASED RISK ASSESSMENT REPORT

HAWLEY AUTO BODY AND PAINT
2902 LYTTON STREET
SAN DIEGO, CALIFORNIA 92110

**Unauthorized Release, San Diego County
File No. H12948-002**

February 2005

Submitted to:
Site Assessment and Mitigation Division (SAM)
County of San Diego
Department of Environmental Health Services
1255 Imperial Avenue, 3rd Floor
P.O. Box 129261
San Diego, CA 92112-9261

Prepared by:
D-MAX Engineering, Inc.
8380 Miramar Mall, Suite 227
San Diego, CA 92121
Tel: (619) 455-9988
Fax: (619) 455-9978

February 14, 2005
Project No. 200329H-2

Dr. Nassir Sionit
Site Assessment and Mitigation Division (SAM)
County of San Diego
Department of Environmental Health Services
1255 Imperial Avenue, 3rd Floor
P.O. Box 129261
San Diego, CA 92112-9261

**Re: Health Based Risk Assessment Report
Hawley Auto Body and Paint
2902 Lytton Street
San Diego, California 92110**

D-MAX Engineering, Inc. (D-MAX) is pleased to submit to the County of San Diego Department of Health Site Assessment and Mitigation Division a Health Based Risk Assessment Report for the Hawley Auto Body and Paint Site. This risk assessment was conducted following the February 2002 recommendation of selecting natural attenuation to remediate groundwater contamination at the project site. A human health based risk assessment is required as part of the site closure by the County and was recommended in your letter dated April 10, 2002. The following report presents the human health based risk assessment for your review.

Should you have any questions regarding this report, please feel free to contact me at (858) 455-9988 extension 22.

Sincerely,
D-MAX Engineering, Inc.

Arsalan Dadkhah, Ph.D., P.E.
Project Manager

cc: Mr. Don Hawley, Hawley Auto Body and Paint

TABLE OF CONTENTS

SECTION	PAGE
1 EXECUTIVE SUMMARY	1
2 SITE DESCRIPTION AND IDENTIFICATION	2
2.1 SITE DESCRIPTION	2
2.2 SITE AND PROJECT IDENTIFICATION	2
3 SITE HISTORY	4
3.1 REMOVAL OF USTs.....	4
3.2 PRELIMINARY SITE ASSESSMENT	4
3.3 ENVIRONMENTAL SITE ASSESSMENT (FEBRUARY 2000)	5
3.4 ADDITIONAL SITE ASSESSMENT (MARCH 2001)	7
3.5 QUARTERLY GROUNDWATER MONITORING (2001-2002)	9
4 GEOLOGY AND HYDROGEOLOGY	11
4.1 TOPOGRAPHY	11
4.2 SURFACE WATER.....	11
4.3 SITE GEOLOGY	11
4.4 HYDROGEOLOGY	11
5 EXPOSURE ASSESSMENT.....	13
5.1 VAPOR PHASE MIGRATION MODELING	13
5.1.1 <i>Soil Gas Concentrations</i>	13
5.1.2 <i>Calculation of Flux</i>	14
5.1.3 <i>Indoor Air Concentration</i>	14
5.2 QUANTIFICATION OF EXPOSURE AND RISK	15
5.2.1 <i>Chemical Intake</i>	15
5.2.2 <i>Risk</i>	16
6 RESULTS AND RECOMMENDATIONS	17
TABLES	
1 SUMMARY OF SOIL ANALYTICAL RESULTS	19
2 SUMMARY OF GROUDWATER ANALYTICAL RESULTS	20
3 VAPOR INHALATION RISK ASSESSMENT CALCULATION FOR MONITORING WELL MW-5.....	23
4 VAPOR INHALATION RISK ASSESSMENT CALCULATION FOR MONITORING WELL MW-6.....	24
FIGURES	
1 SITE VICINITY MAP	25
2 DETAIL SITE MAP	26
3 BENZENE CONCENTRATION TREND AT MONITORING WELLS MW-5 AND MW-6	27

1 EXECUTIVE SUMMARY

The Hawley Auto Body and Paint site is located at 2844 Lytton Street in San Diego. The site was formerly a gas station, which had leaking underground storage tanks (USTs). Although the tanks were removed in 1997, some contamination still exists in the soil and groundwater in the form of petroleum hydrocarbons and gasoline additives. The purpose of this risk assessment is to evaluate the potential human-health risk associated with the underlying contamination at the site. This assessment was prepared in accordance with the County of San Diego Department of Environmental Health, Site Assessment and Mitigation Division (SAM) Manual (DEHS, 2002).

Since 1997, 99 soil samples and 112 groundwater samples have been analyzed to determine the extent of contamination at the site. Using this data, the approximate extent of contaminated soil has been delineated and the areas of significant groundwater contamination have been identified. The groundwater at the site, and throughout most of the Pueblo San Diego Hydrologic Unit, does not have any beneficial uses listed in the Regional Water Quality Control Board's San Diego Basin Plan.

The primary human-health concern from the existing contamination involves the transport of carcinogenic vapors from the contaminated soil and groundwater into the overlying offices. To evaluate this risk, the Vapor Phase Migration Model provided in the SAM Manual 2002 was utilized using site-specific input parameters. Benzene, the most carcinogenic of gasoline compounds, was used as the chemical of concern.

One of the most determinant parameters used in the vapor phase migration model is the soil gas concentration. In the risk assessment presented herein, soil gas concentrations were calculated using data from monitoring wells MW-5 and MW-6, which are the two wells nearest to the office building. The results of the risk assessment modeling indicated risks of 9.79×10^{-7} and 9.31×10^{-7} using the most recent benzene data obtained from wells MW-5 and MW-6, respectively.

Based on the results of the risk assessment calculations, the calculated vapor inhalation cancer risk **is not significant**, as it was less than the acceptable DEH value of 1.0×10^{-6} . The site is recommended for closure.

2 SITE DESCRIPTION AND IDENTIFICATION

2.1 Site Description

The site is located at 2902 Lytton Street, San Diego, California, approximately 200 feet (ft) southeast of Rosecrans Street, as shown in Figure 1. This site is bounded on the south by Lytton Street and on the west by an AM/PM mini-mart and Loma Carwash. To the east side of the site is a motorcycle shop, and to the north of the site are apartments and single-family residential properties. A review of the 1975 U.S. Geological Survey (USGS) 7.5 Minute Quadrangle, Point Loma, California topographic map indicates that the site lies at an elevation of approximately 40 ft above mean sea level (MSL). Currently, the site is operated by Donald L. Hawley, Inc. There are two auto mechanic repair shops within the site, including Nationwide Transmission, and Hawley Auto Body and Paint. The owner wishes to maintain the existing land-use of commercial automotive businesses indefinitely.

Currently, there are nine groundwater monitoring wells at the site. Based on the workplan approved by the County of San Diego, these monitoring wells were sampled on a quarterly basis since March 2001 to October 2004.

2.2 Site and Project Identification

- Site Address 2902 Lytton Street
San Diego, CA 92440
- Name of Business Hawley Auto Body and Paint
- Assessor's parcel number (APN) 450-412-17-00
- SAM Case No. H12948-002
- Property Owner Donald L. Hawley, Inc.
2844 Lytton Street.
San Diego, CA 92110
(619) 222-0371
- UST Owner Donald L. Hawley, Inc.
2844 Lytton Street.
San Diego, CA 92110
(619) 222-0371
- UST Operator Donald L. Hawley, Inc.
2844 Lytton Street.
San Diego, CA 92110
(619) 222-0371

- Contact Person Donald L. Hawley
2844 Lytton Street.
San Diego, CA 92110
(619) 222-0371.
- Consultant D-MAX Engineering, Inc.
8380 Miramar Mall, Suite 227
San Diego, CA 92121
(858) 455-9988 ext. 22
Contact: Arsalan Dadkhah, Ph.D.
- Regulatory Agency Involved County of San Diego
Department of Environmental Health
Site Assessment and
Mitigation Program (SAM)
P. O. Box 129261
San Diego, CA 92112-9261
(619) 338-2222
Contact: Nasser Sionit, Ph.D.

3 SITE HISTORY

3.1 Removal of USTs

On June 17, 1997, Carnevale Construction Management removed a total of five steel underground storage tanks (USTs) along with the dispensers and pipeline materials from the subject site. The USTs included a 500-gallon waste oil tank, a 4,000-gallon diesel fuel tank, a 4,000-gallon gasoline tank, a 5,000-gallon gasoline tank and a 6,000-gallon gasoline tank.

Before the pits were backfilled, several soil samples were collected from the soil underneath the USTs and associated piping and dispenser pumps at different depths as required by Site Assessment and Mitigation Division (SAM). The soil samples under the gasoline and diesel tanks, as well as those underneath the piping systems, were analyzed for total petroleum hydrocarbon gasoline and diesel (TPHg) and (TPHd). The samples underneath the waste oil tank were analyzed for total recoverable petroleum hydrocarbons (TRPH).

The results of the soil testing indicated a non-detectable concentration of TPH under tank Nos. 1, 2 and 4. One soil sample under Tank No. 3 indicated a TPHg concentration of 94 milligrams per kilogram (mg/kg). One soil sample under the waste oil tank indicated a TRPH concentration of 17 mg/kg. Under the piping system, soil sample P4-3 indicated a TPHd concentration of 2,500 mg/kg, and soil sample P6-1.5 indicated a TPHd concentration of 370 mg/kg. The results of the laboratory analysis are tabulated in Table 1.

Upon completion of the analysis, the SAM was informed of the results. Due to the level of petroleum hydrocarbon release, the site was classified as an unauthorized release and was assigned case number H12948-002 by SAM, which also requested further site assessment.

3.2 Preliminary Site Assessment

On January 20, 1999, D-MAX Engineering, Inc. (D-MAX) conducted an environmental site assessment at the study area. Four boreholes were drilled at the site, designated BH-1 through BH-4 as shown in Figure 2. BH-1 was drilled to the depth of 32 ft, and the rest of boreholes were drilled to a depth of 26 to 26.5 ft below ground surface (bgs). Soil samples were collected at five-foot intervals from all boreholes. Groundwater was observed at the depth of 26.5 ft bgs. One groundwater sample was collected from borehole BH-1 from a depth of 30 ft below grade. This water sample was collected using a disposable bailer inserted into a perforated pipe.

A total of 21 soil samples and groundwater samples were submitted to D-TEK Analytical Laboratory for analytical testing in accordance with the guidelines of the SAM Manual.

The tests performed on the soil samples included TPHg for all 21 samples and benzene, toluene, ethylbenzene, and xylene (BTEX) on the samples with the highest concentration of TPH at each borehole. The results of the soil chemical analyses are presented in Table 1.

The first five soil samples at borehole BH-1 did not show any concentration of TPHg or TPHd above the laboratory detection limit, but the concentration of TPHg in the soil sample just beneath the groundwater table was 2,230 mg/kg. At this location, benzene concentration was 2.4 mg/kg, toluene concentration was 23.4 mg/kg, ethylbenzene was 17 mg/kg, and total xylene was 79.6 mg/kg.

BH-2 soil samples did not indicate any TPHg concentrations above the laboratory detection limit.

At borehole BH-3, the first three samples at depths 5, 10 and 15 ft below grade indicated non-detected concentrations of TPHg. A soil sample at the depth of 20 ft had a TPHg concentration of 1,290 mg/kg. At this point, benzene concentration was not detected above the laboratory detection limit, toluene concentration was 1.26 mg/kg, ethylbenzene concentration was 0.24 mg/kg, and total xylene concentration was 10 mg/kg.

The first four samples at depths 5, 10, 15 and 20 ft bgs at borehole BH-4 did not indicate any detectable concentrations of TPHg. The soil sample at the depth of 25 ft bgs indicated a TPH concentration of 3,200 mg/kg. For this sample, the benzene concentration was 1.8 mg/kg, toluene concentration was 19.6 mg/kg, ethylbenzene concentration was 20.0 mg/kg, and total xylene concentration was 84.7 mg/kg.

TPHd was not detected above the laboratory detection limit in any of the 21 soil samples.

A groundwater sample was collected from borehole BH-1. No free product was observed during sampling. The results of the laboratory test indicated a TPH concentration of 79,200 micrograms per liter (µg/l), benzene concentration of 2,970 µg/l, toluene concentration of 9,800 µg/l, ethylbenzene concentration of 1,990 µg/l, total xylene concentration of 9,300 µg/l and MTBE concentration of 1,260 µg/l. The analytical results are presented in Table 2.

3.3 Environmental Site Assessment (February 2000)

On February 17, 2000, four 2-inch monitoring wells, which were designated as MW-1 through MW-4, were installed at the site.

Two of the wells were installed south and east of the removed USTs. The purpose of these wells was to provide more information regarding the subsurface conditions in the immediate vicinity of the removed USTs and assess the extent of contaminated soil and groundwater in the northwest- southeast direction.

The other two monitoring wells were installed west (upstream) and southeast (downstream) of the impacted area.

The purpose of the upstream monitoring well was to assess the possibility of migration of impacted groundwater from the Arco station to the study area. The Arco station site is located upstream of site and has had groundwater impacted history. The purpose of the downstream monitoring well was to delineate the downstream extent of the impacted groundwater.

At each monitoring well soil samples were collected at every five-foot interval, and a groundwater sample was collected when drilling was complete. During installation of the four monitoring wells, 23 soil samples were collected and submitted to laboratory for analytical testing. All samples were analyzed for TPH at the full carbon range using Modified Environmental Protection Agency (EPA) Method 8015. At each well, the soil sample with the highest concentration of TPH was also analyzed for BTEX and methyl tert-butyl ether (MTBE) using EPA Method 8020.

Four groundwater samples (one sample for each well) were collected and submitted to the laboratory for analytical testing. No free product was observed at any of the monitoring wells. All samples were analyzed for TPH at full carbon range in general accordance with Modified EPA Method 8015, as well as for BTEX and MTBE in general accordance with EPA Method 8020.

The soil samples at wells MW-1 and MW-4 indicated no concentration of TPH above the laboratory detection limit. Therefore, samples were not analyzed for BTEX and MTBE. At monitoring well MW-2, the TPHg concentrations of 42.2 and 2,360 mg/kg were detected in samples collected at depths of 20 and 25 ft respectively. The results of the BTEX and MTBE analyses for the sample collected at the depth of 25 ft bgs indicated a benzene concentration of 112 µg/kg, ethylbenzene concentration of 2,760 µg/kg, and toluene concentration of 2,220 µg/kg; the total xylene concentration was 19,700 µg/kg. MTBE was not detected in this sample.

At monitoring well MW-3, the soil sample at a depth of 25 ft bgs indicated a TPHg concentration of 1,150 mg/kg. Further analysis for BTEX and MTBE for this sample indicated no detection of benzene concentration, ethylbenzene concentration of 512 µg/kg, toluene concentration of 144 µg/kg and total xylene concentration of 2,080 µg/kg. MTBE was not detected in either sample. The results of soil sample analytical tests are summarized in Table 1.

Groundwater samples were collected from all monitoring wells at the site. No free product was observed during groundwater sampling. The samples were tested for TPH in full carbon ranges, BTEX and MTBE. The analytical results are presented in Table 2.

The groundwater sample from the monitoring well MW-1 showed a trace of

benzene of 0.9 µg/l, total xylene of 2.5 µg/l and MTBE concentration of 79.6 µg/l. No detectable concentration of ethylbenzene, toluene or TPH was reported.

The results of the laboratory tests for the groundwater sample from MW-2 indicated a TPH concentration of 83,200 µg/l, benzene of 5,930 µg/l, ethylbenzene of 1,940 µg/l, toluene of 13,800 µg/l, total xylene of 8,890 µg/l and MTBE of 833 µg/l.

In the groundwater sample from monitoring well MW-3, the concentration of TPHg was 8,240 µg/l, benzene was 19 µg/l, ethylbenzene was 38 µg/l, toluene was 342 µg/l, total xylene was 1,270 µg/l, and MTBE was 94 µg/l.

The groundwater sample from MW-4 indicated no detectable concentration of TPHg, BTEX or MTBE.

3.4 Additional Site Assessment (March 2001)

On January 31, 2001, four additional 2-inch monitoring wells were installed at the site, designated MW-5 through MW-8. MW-5 and MW-6 were installed east and southeast of the previously removed USTs, respectively. MW-7 and MW-8 were installed west and southwest of the removed USTs, respectively. The purpose of these four wells was to further assess lateral and vertical extent of the impacted soil and groundwater at the site in the east and west directions.

During the installation of monitoring well MW-6, it was realized that the collected soil samples were impacted with hydrocarbon products, which indicated that the soil and groundwater delineations were not complete. Another monitoring well, MW-9, was installed on March 7th, 2001 to further assess the southeast extent of the contaminated soil and groundwater.

At each monitoring well soil samples were collected at every five-foot interval, and a groundwater sample was collected when drilling was complete. During the installation of the five monitoring wells, 35 soil samples were collected and submitted to D-TEK Laboratory for analytical testing in accordance with the guidelines specified in the 2000 SAM Manual.

The soil samples at wells MW-5, MW-7 and MW-9 indicated no concentration of TPH above the laboratory detection limit. Therefore, samples were not analyzed for BTEX and MTBE. At monitoring well MW-6, TPHg concentrations of 1,645 mg/kg were detected in a sample collected at a depth of 25 ft below grade. The results of the BTEX analyses for the sample indicated an ethylbenzene concentration of 581 µg/kg. Benzene, toluene, total xylene and MTBE were not detected.

At monitoring well MW-8, the soil sample at a depth of 25 ft bgs indicated a TPHg concentration of 4,090 mg/kg. Further analysis for BTEX and MTBE for this sample indicated an ethylbenzene concentration of 833 µg/kg, toluene

concentration of 961 µg/kg and total xylene concentration of 4,710 µg/kg. Benzene and MTBE were not detected.

TPHd was not detected in either MW- 6 or MW-8. The results of soil analytical tests are presented in Table 1. Based on this data, an estimated area of impacted of soil was delineated and illustrated in Figure 8 of the Additional Environmental Site Assessment Report submitted in March of 2001.

Nine groundwater samples (one for each well) were also collected after drilling was complete. No free product was observed at any of the monitoring wells. Groundwater samples were collected according to the SAM guidelines and submitted to D-TEK Laboratory for analytical testing. The analytical results are presented in Table 2.

The groundwater sample from monitoring well MW-1 showed a concentration of TPHg of 430 µg/l and MTBE of 364 µg/l. Benzene, ethylbenzene, toluene and total xylene were not detected.

The results of the laboratory tests for the groundwater sample from MW-2 indicated a TPHg concentration of 62,000 µg/l, benzene of 4,870 µg/l, ethylbenzene of 1,750 µg/l, toluene of 10,200 µg/l and total xylene of 9,360 µg/l. MTBE was not detected.

In the groundwater sample from monitoring well MW-3, the concentration of TPHg was 7,000 µg/l, ethylbenzene was 330 µg/l, and total xylene was 742 µg/l. Benzene, toluene and MTBE were not detected.

The groundwater sample for monitoring wells MW-4 did not indicate any TPH, BTEX or MTBE concentrations beyond the detection limit.

In the groundwater sample from monitoring well MW-5, the concentration of TPHg was 13,100 µg/l, benzene was 1,620 µg/l, ethylbenzene was 421 µg/l, toluene was 1,650 µg/l, and total xylene was 2,300 µg/l. MTBE was not detected.

The results of the laboratory tests for the groundwater sample from MW-6 indicated a TPHg concentration of 28,900 µg/l, benzene of 990 µg/l, ethylbenzene of 868 µg/l, toluene of 4,080 µg/l and total xylene of 4,050 µg/l. MTBE was not detected.

The groundwater sample from MW-7 indicated a TPHg concentration of 6,180 µg/l, benzene of 4.2 µg/l, total xylene of 168 µg/l and a MTBE concentration of 3.7 µg/l. Ethylbenzene and toluene concentrations were non detect.

The groundwater sample from MW-8 indicated a TPHg concentration of 1,050 µg/l, total xylene of 19.7 µg/l, and a MTBE concentration of 2.3 µg/l. Benzene, ethylbenzene and toluene were not detected.

The groundwater sample from monitoring well MW-9 indicated no concentration of TPH, benzene ethylbenzene, total xylene or MTBE. The only detected concentration in this monitoring well was a trace of toluene at 1.1 µg/l.

3.5 Quarterly Groundwater Monitoring (2001-2004)

In accordance with the workplan dated July 10, 2000, groundwater from all nine wells was monitored on a quarterly basis between February 2001 and October 2004. Monitoring wells MW-1 through MW-4 were also sampled once in February of 2000, just after the construction of these wells. Results from the past four years of groundwater monitoring at the site are presented in Table 2.

During the past four years of groundwater monitoring at the site, the overall pollutant concentrations have not exhibited an easily discernible trend throughout the site. This is evident in TPHg concentrations presented in Table 2. Specific monitoring wells (MW-5, MW-6, MW-7, and MW-8) have shown consistent decreases in certain pollutants, however, results from other wells have been more challenging to interpret. Although a significant decrease of pollutant concentrations was measured at all sampling locations during the May 2001 sampling event, concentrations increased again in August 2001. D-MAX believes the data from May 2001 is inconsistent with the rest of the collected data, and for the sake of presenting an accurate overall summary of the monitoring results, the May 2001 data has been considered with less importance. Summaries of past results from individual monitoring wells are presented below.

MW-1 is located upstream of the primary contaminated area. Results from this well have shown consistently detectable levels of MTBE and small amounts of TPHg, but negligible concentrations of other pollutants. It is believed that this may be caused by either upstream advection of pollutants, or downstream contamination from the ARCO gas station adjacent to the site. This particular ARCO has had previous groundwater contamination problems with high MTBE concentrations detected at a nearby monitoring well to MW-1. Concentrations of MTBE has fluctuated but decreased since the February 18, 2002 sampling event. The potential for contamination from the ARCO facility is further described in the report dated March 2001. During the period of January 2002 to October 2004 sampling, a decrease in MTBE concentration compared with previous years was observed. Benzene has been non-detect since February 5, 2001.

MW-2 is located nearest to the center of the area where the previous USTs were excavated. Pollutant concentrations from this location have been shown to steadily decrease until November 2001, when a subtle increase in BTEX constituents and a sharp increase in TPHg were detected. However since August 2003 pollutant concentrations have decreased at this monitoring well.

MW-3 is located to the south at approximately similar groundwater elevation as the primary area of contamination. Results from the site have shown inconsistent data in previous years. The most recent monitoring results showed a decrease TPHg concentration, while benzene, toluene and MTBE were not detected.

MW-4 is located on the southeastern portion of the site and is laterally

downstream from the primary area of contamination. Benzene and MTBE have not been measured above the detection limit at this monitoring site.

MW-5 is located directly downstream of the primary area of contamination. This site has shown a consistent decrease in pollutant concentrations, although a small increase was observed in November of 2001. The February 2002 results showed decreased concentrations of all contaminants. MTBE concentration has decreased below the detection limit of analysis for four quarters. The most recent monitoring results showed MTBE concentration were again detected but ranged from 43.4 to 65.5 µg/l during the past five quarterly sampling events. Benzene has also decreased from 443 mg/L in June 2003 to 153 mg/L in October 2004 (Figure 3).

MW-6 is also located directly downstream of the primary area of contamination. The site has shown consistent decreases in contamination of all BTEX contaminants. TPHg has also shown an overall decreasing trend but with less consistent results. In August 2003 an increased concentration of all contaminants were observed, however, a general decrease in constituent concentrations have been noted during the past five quarters of sampling. MTBE concentrations were below the detection limits of the analysis during past four quarters. Benzene has also decreased from 260 mg/L to 143 mg/L during the last three quarterly monitoring events (Figure 3).

MW-7 is located upstream of the primary area of contamination and has shown a general decreasing trend in overall contamination. A peak in TPHg and ethylbenzene concentrations was observed in August 2001, which has been decreasing since. During the last three quarterly sampling event, benzene and MTBE concentrations were observed below the detection limit.

MW-8 is located laterally south at approximately similar groundwater elevation as the primary area of contamination. A peak in TPHg was observed in August 2003, which has decreased since. Benzene and MTBE concentration have been consistently noted below the detection limit. xylene was not detected in the last during the last three quarterly sampling events.

MW-9 is located laterally downstream of the primary area of contamination. This site has shown no sign of contamination.

Overall, it is believed that the contaminated plume is migrating primarily in the direction of the flow gradient (east-northeast) via convection, but has not yet been detected in the downstream eastern monitoring well (MW-9). The plume has not migrated laterally to the south, based on the data collected from MW-4. Limited migration may have occurred upstream based on the MTBE data obtained from MW-1; however, this data may also be a result of contamination from the nearby ARCO gas station.

4 GEOLOGY AND HYDROGEOLOGY

The hydrologic setting for the site can be characterized in terms of local topographic expression, surface water and underlying soil and groundwater conditions as follows:

4.1 Topography

A review of the local topography map published by the 1975 USGS 7.5 Minute Quadrangle, indicates the site has an approximate elevation of 40 ft above MSL; the ground surface in the nearby area slopes to the southeast.

4.2 Surface Water

Surface water at the site is limited to storm water runoff generated during storm events. Surface water runoff is directed to street gutters, which drain through a subterranean storm pipe into the San Diego Bay less than one-half mile southeast of the site.

4.3 Site Geology

According to the map entitled "Geology of the Point Loma Quadrangle, San Diego County, California" published by the California Division of Mines and Geology (Kennedy, 1975), the site area is underlain at the surface by the Bay Point Formation, a poorly consolidated, fine and medium grained, pale brown sandstone deposited in the Pleistocene. The older (Eocene) sediments of the Mount Solidad Formation are mapped at a locality approximately 1000 ft northwest of the site, and this unit may underlie the Bay Point Formation in the area. The site and the surrounding areas have been largely developed; therefore no nearby-undisturbed outcrops were available for visual inspection. Visual logging of boreholes, as well as a review of available geologic maps and reports, verified the site geology.

Two subsurface cross-sections have been drawn and were included as Figures 4 and 5 in the Additional Environmental Site Assessment Report, submitted in March of 2001.

4.4 Hydrogeology

According to the Water Quality Control Plan, San Diego Basin (CRWQCB, 1994), the site lies within the boundaries of the Point Loma Hydrologic Area (8.10) of the Pueblo San Diego Hydrologic Unit. Area 8.10 does not have any listed beneficial uses and has been designated as an exception to the municipal use provision of the Basin Plan because beneficial uses in the portions of the basin do not currently exist and are not likely to exist in the future.

During the preliminary site assessment in January 1999, groundwater was encountered at 26.4 ft bgs. During the February 2000 site assessment, the groundwater depth was encountered at the depth of 28.70 ft at monitoring well MW-1, where the land elevation is the highest within the site. The groundwater depth was between 26.26 to 25.86 ft bgs around the removed USTs (monitoring wells MW-2 and MW-3). Finally, the groundwater depth was 22.9 ft bgs at monitoring well MW-4, where the ground elevation is the lowest within the site.

During the February 2002 sampling, the groundwater depth was between 28.65 and 21.12 ft bgs in monitoring wells MW-1 and MW-9 respectively with the groundwater flow gradient approximately 0.0014ft/ft.

During the most recent sampling in October of 2004, the groundwater depth varied between 21.28 ft bgs at MW-9, where the ground elevation is the lowest, to 28.73 ft bgs at MW-1, where the ground elevation is the highest. The groundwater flow direction was calculated to the east with an approximate average gradient of 0.002 ft/ft.

5 EXPOSURE ASSESSMENT

Exposure is defined as the contact of a receptor with a chemical or physical agent. The exposure assessment determines the quantities or concentrations of the chemicals received by the receptors and evaluates the risks associated with such exposure. Exposure assessments generally are performed by determining the concentrations of chemicals in a medium at a location of interest and linking this information with the time that a population is in contact with the chemicals. Exposure assessment also involves estimating human exposures from multiple routes such as ingestion, dermal contact, and inhalation. As a regulatory default, the DEH considers 1.0×10^{-6} , or one in one million, to be the acceptable level of insignificant risk for commercial and residential uses.

For this study, the vapor-phase migration pathway was considered to be the only potentially complete pathway. The worst-case scenario of potential human exposure to the contaminants via inhalation for the site is the vertical diffusion of benzene through soil gas and indoor air. Therefore, the following discussion will focus on the vapor phase migration of benzene into the indoor air of a nearby office building, and the exposure of employees to the contaminant via inhalation. Although other buildings do exist on the property, primarily open automotive garages, these were not considered risk areas due to the constant ventilation that occurs throughout the day.

5.1 Vapor Phase Migration Modeling

This subsection presents the equations used to estimate the soil gas concentration, effective air diffusion coefficient, diffusive vapor flux, and indoor air concentration. These equations are included in the Vapor Phase Migration Model developed by the Vapor Phase Migration Technical Group (SAM Manual 2002). Table 3 and 4 present the calculations for MW-5 and 6 respectively.

5.1.1 Soil Gas Concentrations

For groundwater with dissolved contamination without the presence of non-aqueous phase liquid (NAPL), the standard equation to calculate the soil gas concentration is based on the Henry's Law Constant and is as follows:

$$C_{0sg} = C_w * H \text{ (mg/m}^3\text{)}$$

Where:

C_{sg} = Soil gas concentration (mg/m³)

H = Henry's law constant (dimensionless), 0.224 for benzene

C_w = Concentration in pore water from monitoring wells (µg/L)

In this risk assessment calculation, we utilized the pore water benzene concentrations from two different monitoring wells in the vicinity of the office building (MW-5 and MW-6) and calculated the associated risks from each well. In October of 2004, monitoring wells MW-5 and MW-6 showed benzene concentrations of 153 µg/L and 143 µg/L, respectively. Using these dissolved benzene concentrations, the soil gas concentrations were determined to be 34.27 mg/l and 32.03 mg/l at MW-5, and MW-6.

5.1.2 Calculation of Flux

Soil gas diffusion from the source area to the base of the structure is defined as soil gas flux. The soil gas flux in the study area was calculated based on the following equation:

$$\text{Flux} = \frac{D_e * C_{sg}}{X} * 0.36$$

Where:

Flux of contaminant (mg/hr-m²)

D_e = Effective diffusion coefficient (m²/hr)

X = Depth to contamination in vadose zone (m)

C_{sg} = Soil gas concentration calculated above (mg/l)

The value for the effective diffusion coefficient (D_e) is calculated by using the following equation:

$$D_e = \frac{D_a * P_a^{3.33}}{P_t^2}$$

Where:

D_a = Contaminant diffusion coefficient in air (m²/hr)

P_a = Air filled porosity (dimensionless)

P_t = Total soil porosity (dimensionless)

The effective diffusion coefficient was calculated to be 0.004599 cm²/sec using an air filled porosity of 0.2, a total porosity of 0.3 and an air diffusion coefficient of 0.088cm²/sec. Using the calculated effective diffusion coefficient and a depth to contamination of 8.019 and 7.88 meters for two aforementioned wells, the vapor flux was calculated to be 0.0071 mg/hr-m² and 0.0067 mg/hr-m² at wells MW-5 and MW-6.

5.1.3 Indoor Air Concentration

The maximum indoor air concentration was estimated from the following equation:

$$C_i = \frac{\text{Slab} * \text{Flux}}{\text{Height} * E}$$

Where:

C_i = indoor air concentration (ug/m³)
 Slab = Slab attenuation factor (unitless)
 Height = Room height (m)
 E = Indoor air exchange rate per hour (1/hr)

For this calculation, conservative default values were used to represent the site conditions. The slab attenuation factor was estimated at 0.1, height was estimated at 2.44 meters and the indoor air exchange rate was 0.83 exchanges per hour. Using these values, the indoor air concentration was calculated to be 0.000349 mg/m³ and 0.000332 mg/m³ at wells MW-5 and MW-6.

5.2 Quantification of Exposure and Risk

Exposure point concentrations are the chemical concentrations contacted at a location over the exposure period. In this health-based risk assessment, the exposure point concentration is the indoor air concentration of benzene in the office building. In order to evaluate the risk, the indoor air concentration is used to quantify the chemical intake of a contaminant by a receptor.

5.2.1 Chemical Intake

To calculate the risk to a receptor or individual from specific exposure (intake), the following equation is used:

$$\text{Intake} = \frac{C_i * IR * ET * EF * ED}{BW * AT}$$

Where:

Intake = Vapor phase intake (mg/kg-day)
 C_i = Indoor air concentration (mg/m³)
 IR = Inhalation rate (m³/day)
 ET = Exposure time (hr/24hr)
 EF = Exposure frequency (days/yr)
 ED = Exposure duration (yr)
 BW = Body weight (kg)
 AT = Averaging time (days)

In this risk assessment, the following standard default values were used during the intake calculation:

IR = 20 m³/day
ET = 0.4 hr/24hr
EF = 250 days/year
ED = 25 years
BW = 70 kg
AT = 25500 days

The inhalation default rate as listed above is 20 m³/day. The exposure time utilized for this commercial businesses based on working hours was close to 10 hours per day or 0.4 of a 24-hour period. The exposure frequency is 250 days per year with exposure duration of 25 years. The averaging time is 25500 days and average body weight of 70 kg.

The chemical intake was calculated to be 9.79×10^{-6} and 9.31×10^{-6} using data from wells MW-5 and MW-6.

5.2.2 Risk

To calculate the risk, the intake is applied to the cancer slope factor for the compound of concern. The risk is calculated as:

$$\text{Risk} = \text{Intake} * \text{Slope factor}$$

The cancer slope factor for benzene vapor inhalation is 0.1. Thus, the calculated risks are 9.79×10^{-7} and 9.31×10^{-7} using the data obtained from wells MW-5 and MW-6, respectively.

Summaries of the calculated risks for each monitoring well showing all input parameters are presented in Tables 3 and 4. A brief summary of the risks associated with monitoring wells MW-5 and MW-6, including the soil gas concentration and indoor air concentration, is presented in the table below.

Monitoring Well	Soil Gas Concentration (mg/L)	Indoor Air Concentration (mg/m ³)	Risk
MW-5	34.272	9.79×10^{-6}	9.79×10^{-7}
MW-6	32.704	9.31×10^{-6}	9.31×10^{-7}

6 RESULTS AND RECOMMENDATIONS

There are several questions associated with the risk based decision process as described in Section 6 of the 2002 SAM Manual. One of the questions posed:

“Does the contamination pose an immediate or long-term threat to public safety, human health, or the environment, based on current or future site use?”

This risk assessment was prepared to address this question for the Hawley Auto Body and Paint Shop. The focus of the risk assessment was on the concentrations of benzene measured in groundwater samples from MW-5 and MW-6. These monitoring wells are located in the vicinity of the former underground storage tanks and were selected as sampling points for the risk assessment based on their proximity to the office spaces.

Both MW-5 and MW-6 were observed with a decreasing trend in benzene concentrations (Figure 3). In February 5, 2001, benzene concentrations at MW-5 were measured at 1,620 mg/L. Although benzene concentrations fluctuated from 2001 through 2003, a general decrease was noted from June 9, 2003 at 443 mg/L to 153 mg/L on October 12, 2004. Similarly, on February 5, 2001 benzene was measured at 990 mg/L at MW-6. Concentrations in benzene fluctuated up until the quarterly sampling event on April 4, 2004. During the April 4, 2004 event, benzene was measured at 260 mg/L. Benzene concentration at MW-6 has decreased based on quarterly groundwater monitoring data with the most recent concentration of 143 mg/L on October 12, 2004.

The most recent concentrations of benzene at MW-5 and MW-6 were used to determine the vapor inhalation human health risk. Utilizing the Vapor Inhalation Risk Assessment model, calculations for MW-5 exhibited a risk of 9.79×10^{-7} and MW-6 a risk of 9.31×10^{-7} . The 2004 SAM Manual states

“US-EPA indicated the acceptable carcinogenic risk could range from 1×10^{-4} to 1×10^{-6} with 1×10^{-6} being a level of de minimus risk (assumed to be insignificant risk). As a regulatory default, DEH considers 1×10^{-6} for both residential and commercial use, as the acceptable risk level.”

On the basis of the aforementioned criteria, the concentrations at MW-5 and MW-6 are below the established risk of 1×10^{-6} for benzene.

Therefore, we request closure of the Hawley Auto Body and Paint Shop site based on the following:

1. Groundwater monitoring data has demonstrated an overall general

decrease in pollutant concentrations throughout the site including a decrease in benzene concentrations at MW-5 and MW-6 during the past three consecutive quarterly groundwater monitoring events. The recommended corrective action for remediation of the site by natural attenuation has been effective in decreasing the concentration of constituents. Figure 3 demonstrates the overall down ward trend in benzene concentrations at MW-5 and MW-6.

2. Human health based risk calculations utilizing a vapor intrusion model as specified in the SAM 2004 Manual are below the established DEH risk of factor of 1×10^{-6} for benzene at MW-5 and MW-6.

TABLE 1
SOIL SAMPLE ANALYTICAL SUMMARY

TABLE 2
SUMMARY OF GROUNDWATER SAMPLE ANALYTICAL RESULTS
YEARS 2000, 2001, 2002, 2003, AND 2004
 (All concentrations in µg/l)

Sample Location	Sampling Date	TPHg⁽¹⁾⁽⁵⁾	Benzene⁽²⁾⁽⁵⁾	Ethylbenzene⁽²⁾⁽⁵⁾	Toluene⁽²⁾⁽⁵⁾	Total Xylene⁽²⁾⁽⁵⁾	MTBE⁽³⁾⁽⁵⁾
MW-1	02/25/00	nd ⁴	0.9	nd	nd	2.5	79.6
	02/05/01	430	nd	nd	nd	nd	364
	05/14/01	609	nd	nd	nd	nd	347
	08/20/01	31	nd	nd	nd	nd	409
	11/12/01	nd	nd	nd	nd	nd	458
	02/18/02	135	nd	nd	nd	nd	395
	12/30/02	22.0	nd	nd	nd	nd	99.1
	03/25/03	nd	nd	nd	nd	nd	88.6
	06/06/03	nd	nd	nd	nd	nd	80.2
	08/11/03	34	nd	nd	nd	nd	161
	01/8/04	24	nd	nd	1.24	nd	85.6
	04/02/04	34	nd	nd	nd	nd	98.8
	07/14/04	nd	nd	nd	nd	nd	70.6
	10/12/04	36	nd	nd	nd	nd	103
MW-2	02/25/00	83,200	5,930	1,940	13,800	8,890	833
	02/05/01	62,000	4,870	1,750	10,200	9,360	nd
	05/14/01	14,600	2,130	nd	3,600	4,410	nd
	08/21/01	53,100	2,450	942	4,760	4,620	nd
	11/13/01	94,500	3,110	1,250	7,500	5,160	nd
	02/19/02	73,000	3,490	1,310	8,150	6,550	nd
	12/31/02	12,000	1,280	640	3,370	2,446	nd
	03/26/03	46,000	2,060	969	5,270	4,240	nd
	06/09/03	59,100	2,280	1,350	6,290	5,280	nd
	08/12/03	65,800	2,690	1,640	7,990	6,710	118
	01/9/04	62,900	1,480	926	4,450	3,620	nd
	04/05/04	25,000	1,420	1,010	4,480	3,670	nd
	07/15/04	22,700	1,240	868	4,050	3,250	nd
	10/12/04	10,800	675	510	2,140	1,843	nd
MW-3	02/25/00	8,240	19	38	342	1,270	94
	02/05/01	7,000	nd	330	nd	742	nd
	05/14/01	106	nd	nd	nd	nd	nd
	08/21/01	12,500	nd	222	nd	561	nd
	11/12/01	2,430	nd	39.3	nd	37.9	nd
	02/19/02	9,200	nd	165	nd	340.5	nd
	12/31/02	4,900	nd	159	nd	346.8	nd
	03/26/03	2,130	nd	53.5	nd	64.2	nd
	06/09/03	1,060	nd	28.2	nd	31.4	nd
	08/12/03	15,300	nd	401	nd	856	nd
	01/9/04	9,470	nd	177	nd	382.5	nd
	04/05/04	2,170	nd	38.3	nd	49.15	nd
	07/15/04	1,690	nd	87.8	nd	159.3	nd
	10/11/04	96	nd	4.56	nd	2.50	nd
MW-4	02/25/00	nd	nd	nd	nd	nd	nd
	02/05/01	nd	nd	nd	nd	nd	nd
	05/14/01	nd	nd	nd	nd	nd	nd
	08/20/01	nd	nd	nd	nd	nd	nd

TABLE 2 (CONTINUED)
SUMMARY OF GROUNDWATER SAMPLE ANALYTICAL RESULTS
YEARS 2000, 2001, 2002, 2003, AND 2004
 (All concentrations in µg/l)

Sample Location	Sampling Date	TPHg⁽¹⁾⁽⁵⁾	Benzene⁽²⁾⁽⁵⁾	Ethylbenzene⁽²⁾⁽⁵⁾	Toluene⁽²⁾⁽⁵⁾	Total Xylene⁽²⁾⁽⁵⁾	MTBE⁽³⁾⁽⁵⁾
MW-4 (Continued)	11/12/01	nd	nd	nd	nd	nd	nd
	02/18/02	nd	nd	nd	nd	nd	nd
	12/30/02	nd	nd	nd	nd	nd	nd
	03/25/03	nd	nd	nd	nd	nd	nd
	06/06/03	nd	nd	nd	nd	nd	nd
	08/11/03	26	nd	nd	nd	nd	nd
	01/8/04	nd	nd	nd	nd	nd	nd
	04/02/04	nd	nd	nd	nd	nd	nd
	07/14/04	nd	nd	nd	nd	nd	nd
	10/11/04	nd	nd	nd	nd	nd	nd
MW-5	02/05/01	13,100	1,620	421	1,650	2,300	nd
	05/14/01	726	19.9	nd	1.10	260.6	19.6
	08/21/01	9,280	522	168	593	763	16.1
	11/13/01	14,300	708	263	927	990	20.7
	02/19/02	5,400	232	78.4	314	394	nd
	12/31/02	2,400	206	102	292	399	nd
	03/26/03	5,200	120	127	424	547	nd
	06/09/03	10,800	443	270	901	1,248	nd
	08/12/03	19,600	395	221	673	934	43.4
	01/9/04	5,070	245	136	576	694	34
	04/05/04	4,050	204	170	661	807	55
	07/15/04	5,400	172	190	480	911	54.8
	10/12/04	4,140	153	180	430	797	65.8
MW-6	02/05/01	28,900	990	868	4,080	4,050	nd
	05/14/01	6,880	85.0	nd	nd	2,205	70
	08/21/01	41,300	1,420	845	4,290	2,760	124
	11/13/01	23,700	654	521	1,870	1,315	93.0
	02/19/02	24,000	642	464	1,430	1,355	97.2
	12/31/02	17,200	497	346	1,550	1,309	58.5
	03/26/03	8,300	272	246	1,060	871	nd
	06/09/03	29,200	1,010	798	3,730	2,870	nd
	08/12/03	82,100	2,820	1,420	9,260	6,060	158
	01/9/04	28,000	9.22	318	1,640	1,223	nd
	04/05/04	12,100	260	192	922	636	nd
	07/15/04	9,230	218	179	800	608	nd
	10/12/04	2,760	143	140	547	456	nd
MW-7	02/05/01	6,180	4.2	nd	nd	168	3.7
	05/14/01	1,090	2.4	nd	nd	20.3	nd
	08/21/01	17,800	3.9	121	2.0	83.8	nd
	11/12/01	11,600	1.3	38.2	nd	14.0	nd
	02/18/02	5,600	nd	18.6	1.0	9.3	nd
	12/31/02	4,100	2.02	30.7	nd	20.24	nd
	03/25/03	5,240	4.56	49.5	nd	32.66	nd
	06/09/03	7,300	2.10	61.9	nd	43.4	nd
	08/12/03	24,400	5.65	202	nd	241.6	nd

TABLE 2 (CONTINUED)
SUMMARY OF GROUNDWATER SAMPLE ANALYTICAL RESULTS
YEARS 2000, 2001, 2002, 2003, AND 2004
 (All concentrations in µg/l)

Sample Location	Sampling Date	TPHg ⁽¹⁾⁽⁵⁾	Benzene ⁽²⁾⁽⁵⁾	Ethylbenzene ⁽²⁾⁽⁵⁾	Toluene ⁽²⁾⁽⁵⁾	Total Xylene ⁽²⁾⁽⁵⁾	MTBE ⁽³⁾⁽⁵⁾
MW-7 (continued)	01/8/04	3,770	1.10	29.8	nd	34.57	nd
	04/02/04	2,420	nd	10.2	nd	8.35	nd
	07/14/04	1,040	nd	6.58	nd	4.82	nd
	10/11/04	973	nd	3.94	nd	4.15	nd
MW-8	02/05/01	1,050	nd	nd	nd	19.7	2.3
	05/14/01	97.0	nd	nd	nd	nd	nd
	08/20/01	2,960	nd	11.7	nd	2.3	nd
	11/12/01	5,830	nd	36.3	nd	4.3	nd
	02/18/02	1,890	nd	7.1	1.1	1.1	nd
	12/30/02	1,300	nd	2.18	nd	nd	nd
	03/25/03	1,360	nd	2.53	nd	nd	nd
	06/09/03	2,640	nd	7.52	nd	nd	nd
	08/11/03	6,520	nd	15.1	nd	nd	nd
	01/8/04	1,360	nd	4.13	1.33	nd	nd
	04/02/04	43	nd	1.29	nd	nd	nd
	07/14/04	309	nd	nd	nd	nd	nd
	10/11/04	208	nd	1.00	nd	nd	nd
MW-9	03/12/01	nd	nd	nd	1.1	nd	nd
	05/14/01	nd	nd	nd	nd	3.4	nd
	08/20/01	nd	nd	nd	nd	nd	nd
	11/12/01	nd	nd	nd	nd	nd	nd
	02/18/02	nd	nd	nd	nd	nd	nd
	12/30/02	nd	nd	nd	nd	nd	nd
	03/25/03	nd	nd	nd	nd	nd	nd
	06/06/03	nd	nd	nd	nd	nd	nd
	08/11/03	nd	nd	nd	nd	nd	nd
	01/8/04	nd	nd	nd	1.91	nd	nd
	04/02/04	nd	nd	nd	nd	nd	nd
	07/14/04	nd	nd	nd	nd	nd	nd
	10/11/04	nd	nd	nd	nd	nd	nd

Notes:

¹ TPH = Total petroleum hydrocarbon (in gasoline range) in general accordance with Modified EPA Method 8015.

² Benzene, toluene, ethylbenzene and total xylene analyzed in general accordance with EPA Method 8260B.

³ MTBE = Methyl tert- butyl ether analyzed in general accordance with EPA Method 8260B

⁴ nd = Not detected above the analytical method reporting limit.

⁵ All concentrations in micrograms per liter.

TABLE 3
VAPOR INHALATION RISK ASSESSMENT CALCULATION
MONITORING WELL MW-5

Soil Gas Calculation		
Cw	153	Concentration of compound in groundwater at MW-5 on 10/12/04 (ug/L)
H	0.224	Henry's Law Constant
Csg = Cw * H		34.272 mg/l Soil Gas Concentration
Flux Calculation		
0.01	0.088	Contaminant diffusion coefficient in air (cm ² /hr)
Pa	0.2	Air filled porosity
Pt	0.3	Total soil porosity
De = Da*Pa^{3.33}/Pt² =		0.004599 cm²/sec Effective Diffusion efficient (m²/hr)
X	8.019	Depth to contamination in vadose zone (m)
Fx (De*Csg/X)*(3600/10000) =		0.0071 mg/hr m² Flux
Indoor Air Concentration		
Slab	0.1	Slab attenuation Factor
Height	2.44	Room height (m)
E	0.83	Indoor air exchange rate per hour (1/hr)
Ci Slab*Flux/(Height*E) =		0.000349401 mg/m³ Indoor air concentration (mg/m³)
Chemical Intake (IT)		
IR	20	Inhalation Rate (m ³ /day)
ET	0.4	Exposure time (hr/24)
EF	250	Exposure Frequency (days/yr)
ED	25	Exposure Duration (yr)
BW	70	Body Weight (kg)
AT	25500	Averaging Time (days)
IT = (Ci*IR*ET*EF*ED)/(BW*AT) =		9.79E-06 Vapor Phase Intake (mg/kg-day)
Risk Calculation		
Slope Factor	0.1	
Risk = Intake*Slope Factor =		9.79E-07 Calculated Risk

TABLE 4
VAPOR INHALATION RISK ASSESSMENT CALCULATION
MONITORING WELL MW-6

Soil Gas Calculation			
Cw	143	Concentration of compound in groundwater at MW-6 on 10/12/04 (ug/L)	
H	0.224	Henry's Law Constant	
Csg = Cw * H		32.032 mg/l	Soil Gas Concentration
Flux Calculation			
0.01	0.088	Contaminant diffusion coefficient in air (cm ² /hr)	
Pa	0.2	Air filled porosity	
Pt	0.3	Total soil porosity	
De =	Da*Pa ^{3.33} /Pt ² =	0.004599 cm ² /sec	Effective Diffusion Coefficient (m ² /hr)
X	7.881	Depth to contamination in vadose zone (m)	
Fx	(De*Csg/X)*(3600/10000) =	0.0067 mg/hr m²	Flux
Indoor Air Concentration			
Slab	0.1	Slab attenuation Factor	
Height	2.44	Room height (m)	
E	0.83	Indoor air exchange rate per hour (1/hr)	
Ci	Slab*Flux/(Height*E) =	0.000332282 mg/m³	Indoor air concentration (mg/m³)
Chemical Intake (IT)			
IR	20	Inhalation Rate (m ³ /day)	
ET	0.4	Exposure time (hr/24)	
EF	250	Exposure Frequency (days/yr)	
ED	25	Exposure Duration (yr)	
BW	70	Body Weight (kg)	
AT	25500	Averaging Time (days)	
IT =	(Ci*IR*ET*EF*ED)/(BW*AT) =	9.31E-06	Vapor Phase Intake (mg/kg-day)
Risk Calculation			
Slope Factor	0.1		
Risk =	Intake*Slope Factor =	9.31E-07	Calculated Risk

FIGURE 1
SITE VICINITY MAP

FIGURE 2
DETAIL SITE MAP

**FIGURE 3:
BENZENE CONCENTRATIONS TREND
AT MONITORING WELLS MW-5 AND MW-6**

